MONEY & INVESTING

THE WALL STREET JOURNAL.

TUESDAY, JULY 27, 2004 ~ VOL. CCXLIV NO. 18 ~ ★★★ $1.00

A Look at Market-Moving Numbers—Literally

Wall Street, as ever, confounds. But the mysterious behavior of financial markets attracts academics eager to uncover investing secrets. For the past 40 years, Yale University mathematician Benoit B. Mandelbrot, founder of a branch of mathematics called fractal geometry, has applied his academic theories to financial markets. His findings are explored in a book he has written with Richard L. Hudson, former managing editor of The Wall Street Journal Europe, titled "The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin and Reward." In the following excerpt, ***Richard Olsen*** *(depicted at right), a Swiss fund manager and specialist in mathematical finance, illustrates Mr. Mandelbrot's view of the financial markets: They aren't mysterious, but rather physical systems that ought to be examined scientifically and engineered rationally.*

By Benoit B. Mandelbrot
And Richard L. Hudson

Richard Clark

Zurich

THE NO. 4 STREETCAR heads from the city center, down the eastern lake shore, eventually arriving at the Mill Museum, a four-story, century-old factory now housing worthy exhibitions on cereals, the food industry and the age-old human cycle of famine and surplus, boom and bust. Next door, however, is a kind of laboratory for boom and bust—a test reactor, its founder calls it. "What we're doing is quantum theory for finance," Richard Olsen says.

His company, **Oanda.com**, looks like just another small financial house. Barely 25 people man its market-making screens, trade e-mail with customers or work its computers. Its Web site, on foreign-exchange markets, seems humdrum. It has instant currency converters, live quotes, news, scholarly articles on market theory, trading games, downloadable software to analyze the market, and—now something out of the ordinary—a service that lets you bet real money on currency rates. If you open an account, you get what looks like a front-row seat at a forex dealer's trading screen. On your PC, you can chart the dollar/yen or euro/sterling market, project price movements, work out a trading strategy and then place a bet, with real money. It can be as little as $1. Launched in 2001, the service in early 2004 had about 10,000 customers with trading accounts. Most were amateurs, taking a flutter. But Oanda also attracts some big money. All told, its customers trade about $1 billion of yen, euro, dollar, bhat or pesos a day.

It is, in short, a small-scale model of the real currency market. One problem with almost all economic or financial research is limited information. If you want to study a market, you can get lots of generic numbers—indexes, price quotations, volume. If you are inside a brokerage house, you can supplement that with precise information about what your own clients are doing, and, to some extent, why. But you can never see what other firms' customers are doing. You can

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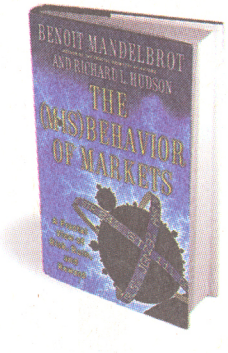

Excerpted from a new book by Benoit B. Mandelbrot and Richard L. Hudson, former managing editor of The Wall Street Journal Europe: **"The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin and Reward."** *©2004, Benoit B. Mandelbrot. Published by Basic Books, a member of Perseus Books Group.*

Behind the Numbers—Literally

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never get the whole picture, the satellite view. That is what Oanda.com provides Mr. Olsen and his handful of math and finance Ph.D.s: the insight, both general and particular, of what people actually do in a market.

"I have this terrible sense of frustration," Mr. Olsen says. "We send space shuttles into orbit; we send probes to Mars; but we haven't studied the financial markets. We literally know nothing about how economics works. I want to break that deadlock. I want to change financial markets into something as efficient as engineering."

Mr. Olsen is a painfully earnest, lanky 51-year-old with a manner more suited to scholar than trader. In the world of forex, where he is well-known among the big bank research departments, he is viewed as something of a boffin: brainy, dedicated and perhaps a bit eccentric. He has a master's in politics and economics from Oxford and a Ph.D. in law from Zurich and worked among the financiers of Zurich. But he quickly became a prophet for an important new faith in financial research: high-frequency data. A century ago, even yearly data on broad trends were hard to come by. Then reporting of monthly, weekly and daily prices improved on exchanges and in newspapers. But the real data stream is tick by tick, quote by quote, transaction by transaction—and that was available only in a few places, such as on the New York Stock Exchange. So in the 1980s, news services like Reuters began to see some value in transmitting instant-by-instant numbers to paying clients—and that is where Mr. Olsen and his colleagues in Zurich saw opportunity. They amassed, debugged and began studying what has become one of the world's biggest databases of tick-by-tick foreign-exchange quotations. For academics, it has been a boon; scores of scholarly finance articles have been published based upon it. But the big banks, to which Mr. Olsen also hoped to sell use of the database, weren't much interested; his firm was liquidated.

Oanda.com was his next idea for studying the market, which he founded in 1996 with a school friend and computer-science professor, Michael Stumm. And it has been an entirely different story. In 2003, according to its reports to the U.S. Commodity Futures Trading Commission, Oanda's net capital more than doubled to $4.1 million—a tidy profit. Olsen Investment Corp., a sister company, manages some relatively small sums—€30 million ($36.3 million) at the end of 2003—for customers in the foreign-exchange market. The funds have performed fairly well. In 2003, the best fund returned 21.05%, the worst, 3.15%, according to audited reports. The performance difference from one fund to the next arises mainly from how much risk, or leverage, each fund tolerates; as is common in forex, the riskiest funds have done the best—so far. But the trading strategy for all the funds is the same, and follows Mr. Olsen's computerized, quasi-fractal models of the market.

To him, a financial transaction is like a small explosion. Conventional financial theory, as taught in business schools around the world, holds that prices change continuously, and that each investor is as unimportant as the next. Their trades are like the collisions of molecules in a gas chamber—millions of tiny energy exchanges. Nonsense, Mr. Olsen says. His tick-by-tick data show plainly that prices jump. Quotes stutter. And investors vary greatly in importance and impact on the market. A more accurate metaphor is the chamber in an internal combustion engine: Millions of small and large explosions drive the car forward, as the sparkplugs fire and the pistons churn.

As he sees it, in a well-functioning market small investors behave much like big investors, and make profits that scale proportionately. Only the industry's unfair commission structure and other idiosyncrasies tilt the game. Likewise, short-term traders act much like long-term investors—again, with measurable scaling factors. He can see this, he says, in the computers tracking his Web service, FXTrade. There, fees are abolished and interest is compounded second by second; big and small investors are on an equal footing as they place their currency bets. To keep the system real, Mr. Olsen is registered as a market-maker, like the behemoths that rule the real currency markets. Mr. Olsen's computers keep his own quotes in line with those of the big banks, and also buy or sell real currency contracts to manage his own risk. Like other market-makers, he earns money on the spread, or the difference between the rates he sets to buy and sell a currency. But to those using his system, all that is invisible: What they see is just a currency market, and they can trade in it as often as they like, with whatever strategy or investment they like.

Mr. Olsen's fractal notions boil down to a theory he calls "heterogeneous markets." Orthodox economics is all wrong, he says. People aren't rational, and they don't all think alike. Some are quick-trigger speculators who pop in and out of the market hundreds of times a day. Some are corporate treasurers, deliberately buying or selling big contracts to fund a merger or hedge an export risk. Some are central bankers, who trade only occasionally, and at critical moments. Others are long-term investors who buy and hold for months or years. Each one, operating on his own time scale, comes together at one moment of trading, like all of time compressing into an instant, or the entirety of a rainbow spectrum focusing onto one white point. That is where the multifractal analysis comes in, he says: It is a mathematical tool for decomposing the market into its different elements and seeing how they interrelate and interact. And it suggests some real-world trading strategies. Using his models, his computers look for moments when the short-term traders are moving opposite to the long-term investors—and then he bets that the imbalance will correct itself.

In the end, he says, his goal is to make the financial system work better and more safely. If the real market worked like FXTrade, costs would come down, liquidity would rise. "The world economy is like your body," he says. "Your heart pumps six liters of blood a minute, and so if you weigh eighty kilos it would take about fifteen minutes to pump your body's weight. By that analogy, the world foreign-exchange market should be transacting $40 trillion every 10 minutes. Today we do $1 trillion or so in 24 hours. My claim is the global economy is close to a heart attack."